



# Forensic

# Medicine



### Sources:

- **Simpson's Forensic medicine 13th edition**
- Lecture notes
- Upgraded version of 436 review file ❤️

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Special thanks to **Aseel badukhon** and **Abdullah alsaeed**

“ This file is a **student work** and it is not a reference ”

*Special thanks to* **ELAAF ALMUSAHEL**

## ★ لا جواباً على ما بعد وجود البطي

اللهم إن في القبور أشخاص نجبهم وأحبونا، اللهم نسألك بكل اسم هو لك أن تغفر لهم وترحمهم، اللهم فسح لهم في قبورهم، واجعلها روضة من رياض الجنة، ولا تجعلها حفرة من حفر النار، اللهم حرم وجوههم على النار برحمتك يا أكرم الأكرمين يا الله

اللهم ابدلهم داراً خيراً من دارهم، وأهلاً خيراً من أهلهم، وادخلهم الجنة، واعذبهم من عذاب القبر، ومن عذاب النار

اللهم ادخلهم الجنة من غير مناقشة حساب، ولا سابقة عذاب، اللهم آنسهم في وحدتهم ، وآنس وحشتهم

اللهم أظلمهم تحت عرشك يوم لا ظل الا ظلك ولا باقى الا وجهك، اللهم بيض وجوههم يوم تبيض وجوه وتسود وجوه، اللهم وثبت قدمهم يوم تزل فيه الأقدام

اللهم إنهم كانوا يشهدوا أنك لا إله إلا أنت، وأن محمداً عبدك ورسولك وأنت أعلم بهم.

# Principles of Forensics

## Permission for Performing Autopsy

The permission is given by:



By the kin (family/relatives) of the deceased in these conditions:

- Private post-mortem examination
- **Clinical autopsy which is performed**

By the coroner in the following conditions:

- Forensic post-mortem examination
- Suspicious death (Medico legal case)



## When to report death to Coroner:

- When the cause of the death is unknown.
- Death was violent or unnatural (suspicious, abuse +/-, iatrogenic, unexpected)
- Unattended, within 24H (arrival, anesthesia, procedure)
- Drugs
- **Death was sudden and unexplained**
- **Person who died was not visited by a medical practitioner during their final illness**
- **Medical certificate is not available**
- **Person who died was not seen by the doctor who signed the medical certificate within 14 days before death or after they died**
- **Death occurred during an operation or before the person came out of anaesthetic**
- **Medical certificate suggests the death may have been caused by an industrial disease or industrial poisoning**
- Death in custody.

## Death Investigation:

- The first step in death investigation is to confirm death and call the paramedics; **authorization by coroner**
- Paramedics always attend the scene **FIRST**
- During death certificate preparation, death mechanism should not be included. (Doctor's note)
- Death investigation is done to identify a person, **cause** and time or **manner** of death? (Not sure)
- The aims of medico legal autopsy are: (Each case has its own purpose)
  - Identify the body
  - Estimate the time of death (**Approximate**)
  - Identify and document the nature and number of injuries
  - Interpret the significance and effect of injuries
  - Identify the presence of any natural disease
  - Interpret the significance and effect of natural disease present
  - Identify the presence of poisons
  - Interpret the effect of any medical or surgical treatment

## Medical Ethics:

- **Patient Autonomy**
- Non-maleficence
- Beneficence
- Honesty (**Providing informed consent**)
- Justice (how healthcare is apportioned when health and financial resources may be **limited**)
- Dignity
- Disclosure: making facts or secrets known; for example telling your patients about the benefits and possible complication of a medical procedure.

# Roles & Assistant Specialities



Allied Forensics

Specialities:

Forensic Ecology	Diatomology	<p>-Scientists based on presence or absence of diatoms in blood and different organs can comment whether or not drowning contributed to death; diatoms are found in the surface of well-lit water.</p> <p>-Diatoms can not pass through GI tract; swallowed diatoms won't enter bloodstream</p> <p>-Diatoms can withstand harsh conditions</p>
	Palynology	<p>-Uses the analysis of pollen, spores and other microscopic entities including insect and plant <u>remains</u></p> <p>-Pollen can be collected from shoes, clothing and tyres when in contact with soils or vegetation. Also, can be collected from nasal cavities when it is an airborne type</p> <p>-Pollen evidence can be used to: 1-Link people or objects to a known scene or deposition site, 2-Identify the geographical locations, 3-Prove or disprove alibis, 4-help to determine the fate of individual prior to death, 5-Help to determine season and location in which an individual died or was missing, 6-Assist in determining the country of origin of illicit drugs</p>
	Entomology	<p>-The application of knowledge about insects (Please remember that palynology deals with the remains of insects) to assist in legal investigations (usually suspicious deaths or murders)</p> <p><b>-Insect analysis can assist in providing information about:</b> 1-An estimated postmortem interval, 2-Whether or not a body has been moved from one location to another, 3-Whether or not a body has been moved between concealed and exposed environment, 4-Whether there has been abuse or neglect, 5-Whether there are public health issues</p>
Forensic Archaeology	<p>-Concerned with the location, recovery and interpretation of buried evidence, mostly human remains and associated items that may be within the grave as well as buried items. Also, will use their knowledge -archeologists- of land surface characteristics to determine whether or not there could be a burial site.</p>	
Forensic Anthropology	<p>-The study of the biological and cultural aspects of humans; Concerned with all aspects of identity, both in living and dead</p> <p>-If there is bones remained in crime scene, an anthropologist will be able to know if it is of humans or animals</p> <p>-Anthropologists, physicians, odontologists and radiologists will all work in a team to estimating age as accurately as possible</p>	
Forensic Odontology	<p>-Odontologists (initially trained as dentists) attempt to identify dental patterns and features and compare these either with known ante-mortem information about the individual or relate such information to known published population data</p> <p>-This process is testing and complex because oral components can hampered by substantial tissue damage and the access to teeth can be hampered by soft tissue damage, rigor mortis or burn damage</p> <p><b>-It is the key technique considered first in mass disaster identification</b></p> <p>-A forensic odontologist should always be asked to make an assessment where a bite mark is suspected in criminal matters (Bite must be of human make)</p>	
Forensic Photography	<p>-A key element of forensic photography is data management of images and how these are stored and reproduced</p> <p>-Forensic photographers are needed to take the highest quality of image of crime scene</p>	
Forensic Toxicology	<p>The use of toxicology and other disciplines such as analytical chemistry, pharmacology and clinical chemistry to aid medical or legal investigation of death, poisoning, and drug use. <b><u>They have Pharmacist background</u></b></p>	

- Fingerprint is listed under the scientific identification
- When a death is suspicious, the coroner should examine the body
- Forensic pathologists are the one to perform autopsy
- Coroner's duty is to authorize human death investigation
- Blood sampling is performed by forensic pathologist while blood analysis is performed by forensic scientist
- Collecting evidence at suspicious death scene is done by pathologists
- Any injury due to the use of gunshot, a **forensic ballistic** must be involved in the investigation

# Principles of Forensic Science



## Locard's Exchange Principle:

-This principle (also known as Locard's theory) in simple form **'every contact leaves a trace'** – provides a basis for the recovery and interpretation of evidence. When applied to a criminal setting it states that if a perpetrator of a crime comes into contact with a scene (or someone within that scene), then something will be brought into the scene, and something will be taken away. It is for the forensic practitioner to identify what those types of contact were by identifying the contact and putting it into an evidently sound format the principle can be applied in all settings.

Trace Evidence	This type of evidence can include anything that has been transferred by means such as contact with a surface or a person and this is the practical application of Locard's Exchange Principle. Often the material is very small and requires microscopic examination. Organic material such as pollen can be considered as trace evidence but more often it involves man-made materials such as glass, paint and fibres.		
Examples	Glass	Paint	Fibers



## Scene Examination:

-The aim is to secure, identify and preserve evidence that may have value in a subsequent court setting. All people accessing or leaving must sign a 'scene log'. The scene will be guarded by police or other security personnel. Once items of forensic interest are found, they are recorded appropriately and assigned an affidavit or exhibit number. The item is usually photographed before being removed carefully. There are several different types of packaging that can be used for different items. Paper sacks are used for clothing because, if the item is slightly damp, this allows moisture to pass through. Plastic bags can be used for items such as cigarette ends. Plastic tubes that screw together are used for sharp items.

Evidence Recovery	Chain of Custody
Once items of forensic interest are found, they are recorded appropriately and assigned an affidavit or exhibit number. The item is usually photographed before being removed carefully. There are a number of different types of packaging that can be used for different items. Paper sacks are used for clothing because, if the item is slightly damp, this allows moisture to pass through. Plastic bags can be used for items such as cigarette ends. Plastic tubes that screw together are used for sharp items.	Once an exhibit has been created, each time it is transferred from one place to another, the details need to be recorded. This is the 'chain of custody'. This is achieved by using continuity forms which demonstrate that the exhibit has been passed from one person to another. The chain of custody is absolutely necessary for admissible evidence in court.

# Principles of Forensic Science



## Sample Analysis:

-Includes multiple samples that can be tested, such as: DNA, Semen, Blood, Saliva, Urine and Feces.

The most prevalent type of DNA profiling utilizes the fact that there are apparent (comparatively) short regions on chromosomes that repeat themselves a number of times. These are called short tandem repeats (STRs). These are believed to be non-coding and are conserved from generation to generation. The number of repeats varies between individuals, but the range of variation is relatively low and, by themselves, each STR (so-called allele) occurs quite commonly (generally between 5 percent and 20 per cent of the population). A person can have the same (homozygous) or different (heterozygous) STRs at each region (locus) that is analyzed.

**A Forensic DNA Analyst performs the analysis.**

### Blood Pattern Analysis

It is the study and analysis of bloodstains at a known or suspected crime scene with **the purpose of drawing conclusions about the nature, timing and other details of the crime**. It is one of the several specialties of forensic science. It **assists** in death investigation



## Others:

### Damage

When items are broken, it can be possible, by visual and microscopic examination, to tell whether or not two or more items are fragments of one original item. By examining the edges and fibre damage to clothing items that have been torn or cut, it may be possible to comment on what type of damage actually occurred as in many cases where allegation of tearing occur.

### Footwear

Footprints at a crime scene do not come from a bare foot, therefore, shoe prints are identified by the analysis of footwear manufacturers, model, shoe size and help profile witness, suspects and victims at a crime scene.

### Fire Investigation

Fires are investigated by a wide range of professionals for a diverse range of objectives. all the investigators will be interested in determining two principal facts:

1. The origin of the fire must be determined
2. A consideration of what might have started it

# Identify Death & Autopsy



## Primary Criteria

- Fingerprints
- DNA
- Dental and unique medical characteristics

## Secondary Criteria

- Features such as deformity, marks and scars
- X-rays
- Personal effects and distinctive clothing

-Additional techniques such as gait analysis from CCTV can be useful when other features can't be used

-The fingerprints can be obtained from desquamated skin or from the underlying epidermis after shedding of the stratum corneum following prolonged submersion

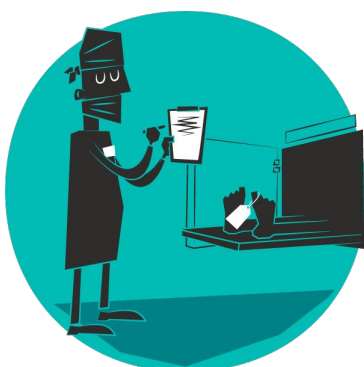
-Proper identification of a body is an important part of the coroner's job. If decomposition or post-mortem changes are not advanced **visual identification the first approach to identify the person**. Other techniques may be required to confirm identify if the changes are too advanced such as if there is substantial injury (e.g. in aircraft crashes or bombings) or deliberate mutilation

Technique	Definition
<b>DNA Profiling</b>	The specificity of DNA profiles is so great in statistical terms that it can be reliably specific to any individual. Comparison of DNA profiles with assumed or known family members or against known databases can ensure a person's identity is established. If these comparisons cannot be done, other tests must be used.
<b>Examination of Dental Structures</b>	Done by a <b>Forensic odontologist</b> . used in the establishing or confirmation of identity when bodies are found, or after mass disaster. Pre-existing dental records and charts and radiographic images are used for comparison. <b>The forensic odontologist is of prime importance in mass disasters where trauma is likely to make visual identification impossible Where no previous records are available</b> , examination of the mouth and the teeth can still give some general information on age, sex, diet and ethnic origin.
<b>Fingerprints</b>	-The recovery of the fingerprints from decomposing and damaged bodies requires the use of specialized techniques which are the province of the fingerprint expert. -A fingerprint can be described as loops, whorls or arches, describing the overall appearance of the ridges when taken together. A forensic fingerprint analyst is the one who performs this analysis.
<b>Morphological Characteristics</b>	Such as height, weight and general physique, hair colour and length, including bleaching or dyeing, the presence of a beard or moustache and the amount and distribution of other body hair, including sites that are commonly shaved, all need to be established. Skin pigmentation, racial and ethnic facial appearances, they all need to be recorded and compared.
<b>Tattoos and body piercings</b>	The main use of tattoos and piercings in forensic medicine is in the identification of the bodies of <b>unknown persons</b> . Body piercing is widespread, and the site and type of piercing should be noted and <b>piercings can be used as part of visual identification</b> .

# Identify Death & Autopsy



1-External Examination		2-Autopsy (Internal Examination)
<p><b>-Stage One:</b>            1-Check the body for any visible signs of injury (These injuries are most likely had caused death)            2-Examining the wounds and measuring them (done by the pathologist)            3-Examining the clothing for any signs of excreted bodily fluids and/or fibers            *At this stage, the pathologist and scenes of crime officer and also authorised police personnel are present to check the body in process known as a preliminary examination            **Pathologist will point out the wounds and injuries to the scenes of crime officer so they can take photos of them</p>	<p><b>-Stage Two:</b>            1-Determine height and weight            2-The clothes of the deceased are thoroughly checked for fibres, hairs, bodily fluids and blood stains; as well as for tears and rips that might correspond to knife or gun attacks.            3-Checking the body for any signs of rigor mortis and lividity            3-X-rays to determine visible head injuries if found            *This stage aims to ensure that no additional post mortem injuries have been sustained</p>	<p>An autopsy takes the form of six stages: (Done by the pathologist)</p> <ul style="list-style-type: none"> <li>● Y-Incision</li> <li>● Removal of Organs</li> <li>● Stomach Contents</li> <li>● Sample Collection</li> <li>● Head and Brain examination</li> <li>● Conclusion</li> </ul> <p>*Y-incision procedure is gain an access to the body's major organs. And the cut from either shoulder to the lower end of the sternum and then downwards in a straight line over the abdomen to the pubis.</p> <p>*Remove the organs and weight them (Some diseases can change the weight of organs)</p> <p>*If no physical injuries then samples must be obtained (blood, DNA, semen..etc) and toxicological tests are carried out on the heart for signs of poisoning</p> <p>*Examining the contents of the stomach can determine when the victim last had a meal and also what that meal consisted of. This is vitally important if determining time of death is a major factor</p> <p>*Samples of bile from the gallbladder, ocular (eye) fluid, liver tissue and urine are also taken for toxicology testing as some poisons may not show in one part of the body but will show in others.</p> <p>*Once these procedures have been completed the pathologist will then turn his or her attention to the head area. The first thing they will do is look for signs of head injury, which should have been visible during both external examinations</p> <p>*The pathologist makes a triangular incision across the top of the scalp to reveal the brain and first of all examines it inside the head. Then once this has been completed satisfactorily the brain is removed for a more thorough inspection and also for tissue samples to be taken.</p> <p>*After all of these procedures have been carried out the organs are then placed back into the body and the body is carefully sewn up again.</p>



*"Each step of autopsy must be carefully documented; you may be called at the court!"*



# Identify Death & Autopsy



Things to keep in mind regarding postmortem examinations:

- During examination of neck, strangulation and hanging marks have prime forensic importance
- Orifices, back and axilla are commonly missed during postmortem examination
- The most commonly documented finding during external examination is the face
- The first crucial part part of an autopsy is identification



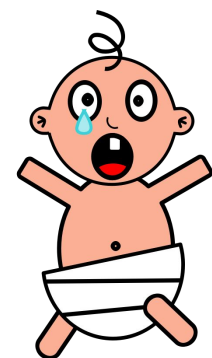
Samples to check for sexual assault:

Sample type	What maybe identified by analysis
Blood	Presence and amount of alcohol; identify DNA
Urine	Presence and amount of alcohol and drugs
Hair (head), cut and combed	Identify biological fluids (wet and dry); foreign material; comparison with other hair founds on body; past history of drug use
Hair (Pubic), cut and combed	Identify biological fluids (wet and dry); foreign material; comparison with other hair founds on body; past history of drug use (Prescribed; licit and illicit)
Buccal scrape	DNA profiling
Skin swabs (At sites of contact)	Identify biological fluids (wet and dry); cellular material; lubricant (e.g. KY, Vaseline)
Mouth swabs	Identify semen
Mouth rinse	Identify semen
Vulval swabs	Identify fluids; foreign material
Low vaginal swabs	Identify body fluids; foreign material; identify biological fluids; foreign material?
High vaginal swabs	Identify body fluids; foreign material; identify biological fluids; foreign material?
Endocervical swabs	Identify biological fluids
Penile swabs (shaft,glans, coronal sulcus)	Identify biological fluids
Perianal swabs	Identify biological fluids
Anal swabs	Identify biological fluids
Rectal swabs	Identify biological fluids
Fingernail swabs, cuttings or scraping	Identify foreign material, matching of broken nail

# Manner of Death

Manner (mode) of death	Details
Natural	Natural is defined as death caused solely by disease or natural process. If natural death is hastened by injury (such as a fall or drowning in a bathtub), the manner of death is not considered natural.
Accidental	An unnatural death resulting from an inadvertent chance happening. Traffic related fatalities (involving vehicles used for transportation on any public roadway) are classified as accidents. On the job injury related deaths are referred to as industrial deaths and are classified as accidents. Deaths related to illicit drug or excessive medication use, in the absence of specifically supporting the conclusion of the manner of death being homicide or suicide, are classified as accident. Also, complication of therapy are considered accidents.
Suicide	self-inflicted injury with evidence of intent to die. Evidence of intent includes an explicit expression, such as a suicide note or verbal threat, previous attempts, or an act constituting implicit intent. An example would be a self-inflicted contact/close range gunshot wound (particularly of the head, chest, or abdomen) that is recognized as having very high potential for lethality, and is considered to be implicit evidence of intent to die.
Homicide	Homicide is defined as the action of one person directly causing the death of another. A death that occurs during and is related to the commission of a felony is also considered homicide. A violent death may stem from some kind of deliberate or purposeful action, but intent to cause death need not be present or proven for the classification as homicide. Homicide and murder are not the same. All murders are homicides, not all homicides are murder. "Murder" is not an acceptable manner of death classification for death certification purposes. "Murder" is a term used under specific conditions in criminal law matters as a general concept. An example might be that of unintentional firearms-related hunting death. While it may be classified as a homicide, it is up to legal authorities to determine when to prosecute such a case as "murder," "manslaughter," etc.
Undetermined	Undetermined is an appropriate designation for cases that have very little available information about the circumstances surrounding the death (e.g., partial skeletal remains) or where known information equally supports, conflicts with, more than one manner of death. An undetermined manner of death is assigned to cases of unnatural death when a clear preponderance of evidence supporting a specific manner (homicide, accident, or suicide) is not available. Some unexpected infant deaths that are not classified as "natural" (SIDS), such as when an unsafe sleeping environment is present, may be classified as "undetermined" in manner.
Pending	Pending may be listed temporarily on the death certificate for cause and/or manner when additional investigation, information and/or test results are required for certification.

Sudden Unexplained Infant Death (SUID), formerly known as sudden infant death syndrome (SIDS), is a subset of natural death. It is the sudden death of an infant under one year of age which remains unexplained after a thorough and complete investigation. The investigation includes a complete autopsy, examination of the death scene, and clinical history. If significant risk factors were present, such as an unsafe sleep environment, including co-sleeping or inappropriate bedding, then the cause of death would fall out of the definition of SUID and the manner would be classified as "undetermined."



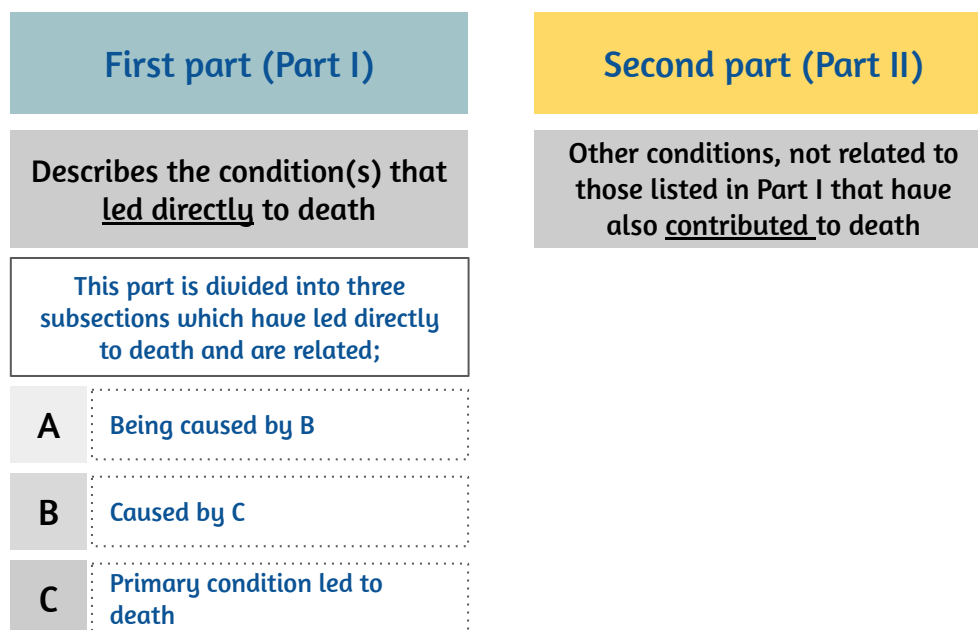
Infant Sudden Death Syndrome

# Cause of Death

## Meaning of Cause of Death:

It is the cascade of events that sufficient to have caused death; sometimes the deceased can present with complex of underlying diseases and injuries but among them there is that substantial and significant cause. In other words, it was necessary for such illness or other factor to have occurred for the outcome to be fatal.

### Cause of death is divided into two parts:



→ When issuing a death certificate, a doctor shouldn't record mode of death (e.g. coma, heart failure) in isolation but if it is specified then it has to be qualified by indicting the underlying pathological abnormality that led to it; Hypertrophic cardiomyopathy (Primary condition) >> Cardiac failure (mode)

CAUSE OF DEATH (See instructions and examples)	
<small>32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.</small>	
<small>IMMEDIATE CAUSE (Final disease or condition resulting in death)</small>	a. <u>Acute myocardial infarction</u>
<small>Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST</small>	b. <u>Atherosclerotic coronary artery disease</u>
	c. _____
	d. _____
<small>PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I.</small>	

# Cause of Death



## Things to keep in mind:

- Diabetes is NOT a cause of death
- You should recognize post-mortem findings of each agent that led to someone's death so you can identify it; cherry-red discoloration of skin in dead person implies Asphyxiation due to acute CO poisoning as a cause of death
- Healthy, young and athlete, suddenly died >> Hypertrophic cardiomegaly is the cause of death
- Postural asphyxia >> Intoxicated individuals (alcohol consumption which causes impairment in consciousness)
- **Immediate cause of death** is typically defined as the disease or injury directly leading to death, **Underlying cause of death** is defined as the disease or injury that initiated the train of morbid events leading directly to death or the circumstances of the accident or violence that produced the fatal injury.
- Sudden death with chronic alcohol history >> Cause of death is Dilated Cardiomyopathy



## Examples of Asphyxial Conditions:

Lack of oxygen in the inspired air	Suffocation
Blockage of the external orifices	Suffocation/Smothering
Blockage of the internal airways by obstruction	Gagging/choking
Blockage of the internal airways by external pressure	Strangulation/hanging
Restriction of chest movement	Traumatic asphyxia
Failure of oxygen transportation	E.g. CO poisoning
Failure of oxygen utilization	E.g. Cyanide poisoning

# Postmortem Changes

## Rigor Mortis VS Livor Mortis VS Algor Mortis:

Rigor Mortis	Livor Mortis (Post-mortem Hypostasis)
<p>A <u>temperature dependent</u> physicochemical change that occurs within muscle cells as a result of lack of oxygen (hypoxia); low ATP and high acidity will cause both actin and myosin to bind together and form a gel.</p>	<p>Cessation of the circulation and the passive settling of red blood cells under the <u>influence of gravity</u></p>
<p>-This process develops faster when the muscles are already fatigued at the time of death; low muscle glycogen or acidic muscles                      -Lower muscle bulk &gt;&gt; Harder to detect this process                      -<b>First detectable in the smaller muscle groups; around the eyes, mouth, jaw and fingers.</b>                      -Can be used <u>to estimate time</u>                      -Cold temperature <u>slows down</u> this process whereas hot temperature <u>accelerates</u> this process</p>	<p>-Position of the body can affect this phenomena; if a person was left suspended after hanging, deep hypostasis will occur in lower legs and arms. And also this can cause overlapping patterns when it comes to estimate time of death (<u>you can't use it for estimating time of death but you use it for determining position</u>)                      -Pressure to particular area causes pallor; such a thing is significantly important in terms of forensics because if such pallor was found around the mouth and nose then this may imply suffocation.                      -Color of hypostasis is variable and in some conditions can lead to the cause of death; sometimes but NOT all the times.</p>
Algor Mortis	
<p>Algor mortis refers to the postmortem cooling of a body that takes place after death. As the body temperature is equilibrating with the environmental temperature this usually involves cooling, but it can occasionally result in warming of a body in conditions of extreme heat.</p>	
<p>-Can be affected by many factors (rate of cooling) such as; Mass of the body and clothing</p>	

- All of these three post-mortem changes are **EARLY** changes.

## Marbling:

Decomposed hemoglobin presenting in the superficial vessels which will result in linear branching patterns of variable discoloration of the skin.

# Postmortem Changes



Examples of postmortem changes and their causes:

- **Petechiae and cyanosis >> Smothering**
- Neck findings >> Hanging
- Missing head and hands after death in opened areas such as valleys and forests implies animal activity
- Purple/pink discoloration of the face and pallor around the mouth and nose (no evidence of trauma) >> These changes are called Livor mortis but why the pallor? This indicates an act of smothering (blocking external orifices -nose and mouth-) prior to death which caused pressure and that prevented blood supply to that area so lividity won't appear at such site
- Myocardial microinfarcts >> Captagon use (Stimulants)
- Deep furrowed, parchment abrasion around the neck below chin with a posterior neck suspension gap >> upright hanging
- Multiple burns, blisters and scorching. Areolar pallor with hyperemic rim >> electrocution



## Mummification

Happens when a body is lying in a dry condition. Both Climatic or in a microenvironment may make the body desiccate instead of putrefying. The process is known as mummification.

Tissue is dry and leathery and often brown in color. It is most commonly seen in warm or hot environments such as desert and led to the spontaneous mummification of bodies buried in the sand in Egypt.

Mummification doesn't affect the whole body, some parts may still show the normal soft tissue decomposition changes.



## Adipocere

Adipocere is a chemical change in the body fat, which is hydrolysed to a waxy compound not unlike soap. The need for water means that this process is most commonly seen in bodies found in wet conditions.

# Injury



## Types of Injury:

### Physical Force

- Blunt Force (Not caused by instruments)
- Sharp Force (Caused by instruments)

### Non-physical Force

- Thermal
- Chemical
- Electrical
- Electromagnetic

## Classification of wounds:

Type	Details
Bruises	<ul style="list-style-type: none"> <li>-Two events must occur before a bruise forms: 1-Damage to a blood vessel, 2-Leakage of blood into surrounding tissues</li> <li>-The extent of this injury is related to the applied force; greater force, bigger bruise</li> <li>-Commonly is seen in skin but can occur in deeper tissues</li> <li>-<u>Bruise</u> is the leakage of blood into skin and subcutaneous tissues, <u>Contusion</u> is the leakage of blood into body cavities, <u>Hematoma</u> is the palpable blood collection under the skin. &lt;2 mm bruise is called <u>Petechiae</u></li> <li>-Pattern of bruise can be varied according to the shape of applied force</li> <li>-Can occur after death</li> </ul>
Abrasions	<ul style="list-style-type: none"> <li>-Superficial injury that doesn't penetrate the entire thickness of epidermis</li> <li>-Caused by the contact between a rough surface and the skin. Also, can be caused by crushing of the skin; vertical force.</li> <li>-Abrasion found in hanging &gt;&gt; Typical crush abrasions</li> <li>-The appearance of abrasions help in determining the exact point of contact</li> <li>-Three types of abrasions: 1-Scratches, 2-Scuff (brush) abrasion, 3-Point/gouge abrasion (Deeper)</li> <li>-Superficial abrasion doesn't bleed but <u>deeper does and have typical punctate or spotty appearance</u></li> </ul>
Lacerations	<ul style="list-style-type: none"> <li>-Cuts or splits forming "Bridging fibers" in the skin; bridging fibers are exposed blood vessels or nerves in the defect. <u>Bridging fibers are the hallmark of lacerations</u></li> <li>-Caused by blunt force applied to the skin; can go deeper and cause profuse bleeding</li> <li>-Most common areas for lacerations are where the skin can be compressed between applied force and underlying bone; scalp, face, elbows, knees, shins. Rare in soft fleshy areas unless you applied severe force; buttocks, breasts and abdomen</li> <li>-Vehicle wheel &gt;&gt; Horizontal laceration which is called flaying or degloving</li> <li>-Appearance of laceration <u>doesn't</u> reflect the nature of the impacting object (Abrasion <u>does</u>)</li> </ul>
Incisions	<ul style="list-style-type: none"> <li>-Caused by objects with a sharp or cutting edge (most commonly a knife)</li> <li>-The edges of wound can help in knowing the sharpness of the weapon</li> <li>-NO bridging fibers are seen</li> <li>-Fatal incision are those made where major arteries lie in more superficial tissues such as wrist or neck</li> <li>-Incision is distinguished from a stab wound by being longer than it is deep</li> </ul>
Stab wounds	<ul style="list-style-type: none"> <li>-Caused by sharp implement but <u>it is deeper than it is long</u>; can be caused by relatively blunt objects</li> <li>-Depth can be measured in dead people but not in livings</li> <li>-Appearance of a stab wound can determine the shape and size of the used weapon</li> </ul>

- The most dangerous type of wound is Stab penetrating wound.
- The commonest sharp weapon used in assault is a knife
- Bleeding tendency has more effect in the occurrence of contusion
- Healed wounds >> Scars
- Horizontal wounds caused by sharp object >> Incisions
- Frontal and Temporal cerebral contusion can be caused by Contrecoup injuries

# Motor Vehicle Accidents



## Categories of road traffic injuries:

Category	Details
<b>Pedestrians</b>	<ul style="list-style-type: none"> <li>-The most commonly injured</li> <li>-Two types of injury: Primary (Direct contact with the vehicle) and Secondary (Contact with other objects after contact with vehicle)</li> <li>-Primary Injury: Recognizable pattern “Tyre Tread” (some factors can alter this pattern), Speed of car can affect the type of injury*. A pedestrian struck by the front of a car may be projected forwards or lifted onto the vehicle; ‘bumper injuries’ including a compound fracture of the right leg, and laceration of the left knee, probably following primary impact to pedestrian’s right leg.</li> <li>-Secondary Injury: more serious and lethal.</li> <li>-Traumatic Brain Injury (very common)**</li> <li>-Run over injuries; associated with flail chest “compression of ribs”</li> <li>-Flaying injury; stripping off the skin</li> </ul>
<b>Cyclists (pedal or motor)</b>	<ul style="list-style-type: none"> <li>-Motorcycle: injuries commonly caused by falling, abrasions are caused by being in contact with the road, head injuries are the most common cause of morbidity and mortality, injury to (chest, limbs and spine) are also common.</li> <li>-Pedal cycle: Primary injuries are usually mild to moderate because of the low speed of cycle unless impacted by a vehicle, here could be fatal. Secondary injuries are commonly involving head and chest</li> </ul>
<b>Drivers/Passengers of vehicle</b>	<ul style="list-style-type: none"> <li>-Four types of impacts: 1-<b>Accelerate (hit from behind)</b>, 2-<b>Decelerate (hit from front)</b>, 3-Side impact and roll-overs (least common)</li> <li>-The degree of injury sustained by the occupant is very much dependent on the vehicle’s speed at the moment of impact, its deformation properties and the structure of the part (or parts) of the vehicle being impacted by the occupant</li> <li>-Types of injuries in unrestrained occupant (look for image below)</li> </ul>

### Box 14.1 Injuries that may be expected to occur in an unrestrained impact/collision

- The face and head hit the windscreen glass, frame or side-pillars, causing skull and facial fractures, injury to the brain and its coverings, and cervical spine injury.
- The chest and abdomen contact the fascia or the steering wheel, causing rib, sternal, heart and liver injuries.
- The momentum of the heart within the thorax, perhaps aided by hyperflexion, may tear the aorta at the termination of the descending part of the arch, at the point where the vessel becomes attached to the vertebral column.
- The legs of the passenger are thrown forwards and the knees may strike the parcel shelf, causing fractures.
- The legs of the driver, which are commonly braced on the brake and clutch pedals, may transmit the force of impact along the tibia and femur to the pelvis. All of these bones may be fractured or dislocated.
- On the rebound from these impacts, the heavy head may swing violently backwards and cause injury to the cervical or thoracic spine.
- The occupants of the car may be ejected out of the vehicle through the windscreen, increasing the risks of secondary injuries or being run over by another vehicle.

\*At relatively low speeds (e.g. 20 kph/12 mph), the victim may be thrown off the bonnet either forwards or to one side. Between 20 and 60 kph (12–36 mph), the pedestrian may strike the bonnet (hood) and the head may strike the windscreen or the surrounding metal body work. At higher speeds (60–100 kph/36–60 mph), pedestrians may be projected up into the air; sometimes they will pass completely over the vehicle and will avoid hitting the windscreen and other points on the vehicle. Such impacts, however, will generally cause major injury, including complex fractures or traumatic amputations.

\*\*This occurs as a consequence of the rotational, deceleration forces produced when the rapidly moving head is suddenly stopped at impact, leading to ‘shearing’ injuries to the brain and its coverings.



- When describing the cause of death in transportation: First (identity the position of the victim “A driver (car or a cycle) or an occupant (front seat or not, restrained or not)”), Second is it front impact (decelerate) or from behind (accelerate), third: type of vehicle. For an example: Blunt force injury, automobile collision, pedestrian versus car.
- Railway lines are a common site for suicide attempts.



# Ballistics & Weapons



Types of firearms and their injuries:

Smooth Barrels	Grooved (Rifled) Barrels
Fire groups of pellets or shot	Fire single projectiles or bullets
<ul style="list-style-type: none"> <li>-The further away from the gun&gt;&gt; larger spreading of the pellet &gt;&gt; larger damage</li> <li>-Contact wounds</li> <li>-Circular entrance wound that approximates the size of the muzzle, regular edge, clear-cut appearance with no individual pellet marks, smoke soiling at some of the margins, narrow circular rim of abrasion around the entrance wound</li> <li>-If the discharge was over an area supported by bone, the gases can't spread (disperse) as they would in soft unsupported areas such as the abdomen</li> <li>-Radial pattern is seen in areas with greater ballooning of the skin</li> <li>-Tissue along the wound track are blackened while the surrounding tissues are pinker than the normal (Carbon monoxide effect)</li> </ul>	<ul style="list-style-type: none"> <li>-Cause both entry and exit wounds</li> <li>-Many of the bullets are retained within the body because they didn't possess enough energy to complete the passage (So, damage also depends on the energy contained within the bullets, not only the only the distance of the shooting)</li> <li>-Contact wounds are circular (if it is smooth surface), splitting if is bony area</li> <li>-Muzzle mark on the skin (if gun is pressed hard against skin)</li> <li>-Local burning of skin and hair (not pressed tightly against skin)</li> <li>-Shape of entry wound gives guide to the angle which was made (Circular hole &gt;&gt; right angle, oval hole &gt;&gt; more acute angle)</li> <li>-Examination of entry and exit wound will reveal; Entry wound will show the skin to be inverted (smaller than missile diameter) while exit wound will show the skin to be everted with split flaps (stellate appearance).</li> </ul>
<p>The internal effects of bullets depend upon their kinetic energy; less velocity and energy &gt;&gt; less damage (mechanical damage). More velocity and energy &gt;&gt; more damage and also formation of temporary cavities*</p>	

\*Cavitation effect is especially pronounced in dense organs, such as liver and brain, but occurs in all tissues if the energy transfer is large enough and can result in extensive tissue destruction away from the wound track itself.